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Using IMPLAN to Evaluate Public Universities Regional Economic Inpacts

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Abstract
This is a how-to manual for utilizing the IMPLAN impact analysis program when measuring the worth of public universities to regional economies. This paper describes four approaches to measuring university economic values ranging from simple modification to the elements of value added to producing highly itemized "bill of goods" types of specifications. It compares the four methods to one another as well as to a formal RIMS II analysis of the same institution by the U.S. BEA.

Disciplines
Behavioral Economics | Growth and Development | Public Economics | Regional Economics

USING IMPLAN TO EVALUATE PUBLIC UNIVERSITIES REGIONAL ECONOMIC IMPACTS

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OVERVIEW

IMPLAN is a widely accepted software and data system used by many professions in academia, government, and the private sector. The program is extremely easy to learn (perhaps too easy), and the entire package of data from IMPLAN plus their procedures for processing those data are very transparent. In short, the program is popular, well-built, user friendly and easily modified.

Measuring the economic contributions of public universities requires IMPLAN to be modified to do the job properly. For one, public universities are considered part of the governments sector of the model *(sector 438 Employment and payroll only-- state & local govt, education*), but the only evaluation that can be done with that sector would involve entering in a college's payroll. It is not appropriate to enter in the remainder of college expenditures in that sector as the remaining amounts of government expenditures are outside of the model and constitute a portion of the final demands territory of a standard input-output model. Public hospitals also have this same limitation – they are part of the state and local governments accounting framework, not separate industries within the health care sector.

The best approach to use for a sector not cleanly found in IMPLAN is called a Bill of Goods analysis (BOG). BOG is the approach that people who rely on RIMS II multipliers at the BEA will often use, most especially for new or unique industrial events that are not well represented by an existing RIMS II industry. A competently done BOG evaluation requires the analyst to not only know the specific expenditures of the industry it is evaluating i.e., its detailed bill of goods, they must also have a sense of within-region versus out of region purchases to really do the job right. The same type of BOG analysis can be done easily in IMPLAN, and IMPLAN allows users to use the model's

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econometrically derived probabilities of local purchases in the absence of information about local purchases.

Some modelers often have simply made do with the private college component of the model *(sector 392 Private junior colleges, colleges, universities, and professional schools)* in estimating university impacts, but here you are using production coefficients that lump Harvard, Phoenix University, Kaplan, DeVries, and Barb's School of Beauty as one big industry average. As these are private institutions, they have a profit motive: consequently, there are components of value added, like investment incomes, and indirect tax payments that are not found in public colleges. In addition, the entire schedule of inputs may differ markedly from public universities. Even in a pinch, in my opinion, it is never justified to use this sector unmodified to measure public universities, as the sector appears in a regional model – it should be modified to be at least minimally acceptable for evaluating public colleges.

That said, there is nothing to prevent us from appropriating that sector, modifying it, and then applying it to our public university economic contribution evaluation.

This paper sketches four approaches to creating a reliable and defensible public universities sector or public universities input-output results using IMPLAN. Two involve modifying the private university sector 392 in IMPLAN. The other two emulate a bill of goods approach to modeling using a garden variety regional IMPLAN model.

METHOD #1. CUSTOMIZING THE STUDY AREA DATA ONLY

This is the "I have to get this done NOW! method." Here I am merely modifying the output, value added, and employment components of the model for sector 392. I am stripping out the private sector value added, employment, and output, and replacing them with our university's characteristics.

Before the modification, however, I need reasonably good information about my university. I am going to use Iowa State University data to illustrate our basic needs. For the purposes of this paper and related research and service on this topic, I processed all of Iowa State University's FY 2010 expenditures into standard IMPLAN or RIMS II categories. Those more detailed spending categories will be applied later in the BOG methods, but for this first method I need merely a decent summary of value added and operational output.

Table 1 provides the information required to customize the study area data for the Iowa study. In IMPLAN, employee income includes wages, salaries, and employer-paid benefits. I have included all other university spending activity, and in this case excluded all spending for capital goods and construction. I am only measuring the university's annual operational contributions at this stage.

TABLE 1

ISU FY 2010 Operational Output Summary

		Amount	Per Job
	Payroll (wages, salaries, plus benefits)	$ 585,435,189	$ 40,134
Plus	Sum of all other spending (with margins applied)	$ 315,074,432	
Minus	Construction and other additions to capital stock	$ (103,624,435)	
Equals	Final demand change	$ 796,885,185	$ 54,630
	Total full-time and part-time jobs	14,587	

With this table in hand, IMPLAN users will next customize the study area data of the regional model. In the main menu, you go to the **Customize** section and click on **Study Area Data**, and then select **Sector 392** (see Figure 1).*

* Words or phrases in **Red-Bold-Print** are meant to refer to actual IMPLAN menu options or choices.

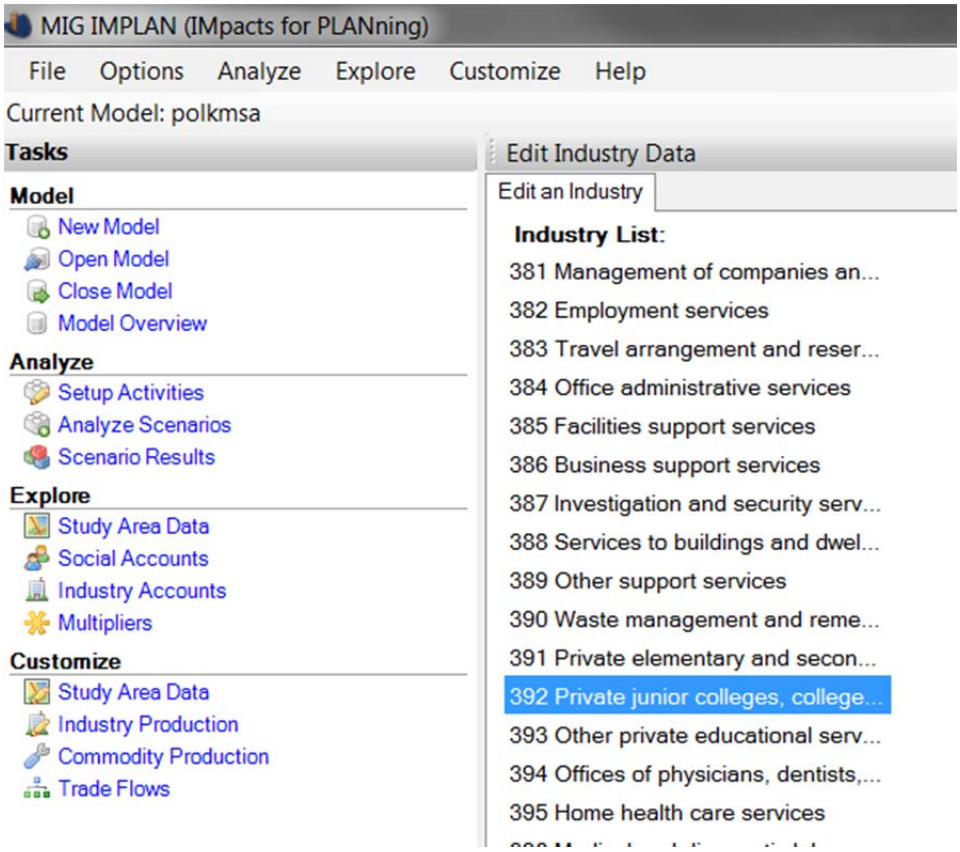


FIGURE 1: CUSTOMIZING STUDY AREA DATA

Figure 2 shows the resulting screen. It also shows that I have inserted the key data in the **Per Worker** column along with the number of jobs. (Readers will trust me on this: Perform your modifications only in the **Per-Worker** column selection in the **Edit Options**, not the **Total** option). You will see that I zeroed-out proprietor incomes, investment incomes, and indirect business taxes. I'm assuming none of these apply to government operations. You next unlock the **Intermediate Expenditures** toggle and click on **Update.** Finally, you need to go back to the main menu and re-build the multipliers (see Figure 3).

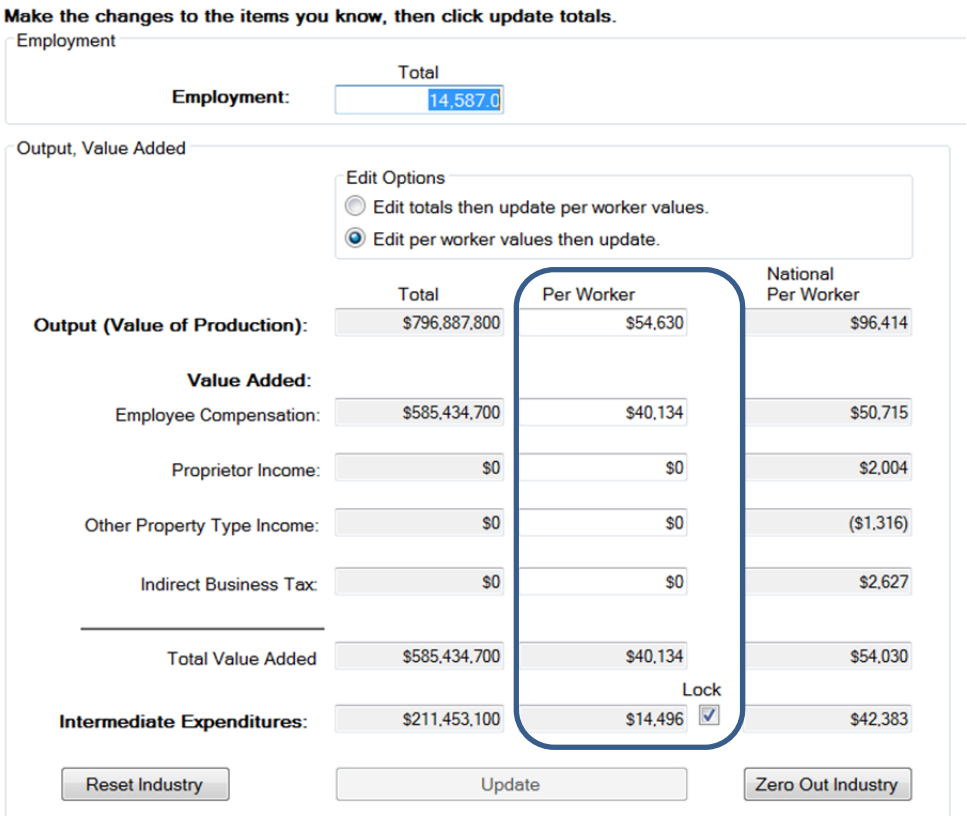


FIGURE 2: EDITING THE PER WORKER VALUES

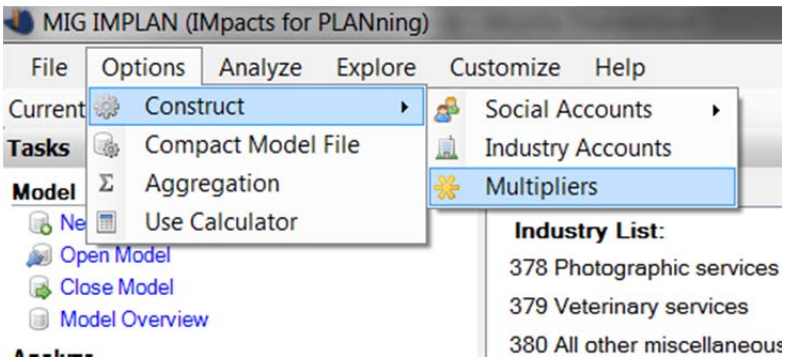


FIGURE 3: REBUILDING THE MULTIPLIERS

After the model has been rebuilt and the multipliers re-estimated, I then enter in either the output change from Table 1 or the jobs change using normal IMPLAN **Analysis / Set-up** procedures from the main menu of options. You move next to the **Analyze / Scenarios** portion of the model, select your activity and analyze your selection. A summary table of this scenario will pop-up after the analysis. (Important note: when viewing the results, it is important to remember to tell IMPLAN

which year the results are for – in this case it is 2010 – because IMPLAN may default to 2014 financial values).

Table 2 presents the findings of this exercise as they would come out of IMPLAN. Just looking at the Total Effect row, we see my university supports a total of 20,390 jobs in Iowa, $788.1 million in labor income to those jobholders, $956.9 million in value added, and $1.42 million in total output.

TABLE 2

Value Added Adjustment With Adjusted University Operational Output

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	14,587	585,434,688	585,434,688	796,887,808
Indirect Effect	1,005	38,629,916	76,876,440	133,448,248
Induced Effect	4,798	163,993,216	294,578,633	489,737,336
Total Effect	20,390	$788,057,820	$956,889,760	$1,420,073,392

METHOD #2: BILL OF GOODS APPROACH USING IMPLAN LOCAL PURCHASE COEFFICIENTS

If you have relatively detailed data on your university's expenditures, you are able to improve your input-output evaluation by using a Bill of Goods approach (BOG) to your analysis.* Here, you are first modeling, item-by-item, all of the indirect inputs into the university. And second you model employee spending. This can be a daunting task. For our participation with the BEA on evaluating university economic impact practices in 2013, Iowa State University provided me with a list of 56,000 line-item expenditures that could be pre-grouped into 280 categories that were useful for university purposes, but not necessarily for impact analysis. Those data were then evaluated and, category-by-category, aligned with standard BEA RIMS II definitions as well as IMPLAN definitions. The university data were also organized to provide us with the zip-code of the payee, which allowed for a complete determination of spending within our study area (here it is the state of Iowa) and spending outside of our study area. That information is used in Method #3.

* Users who are unfamiliar with this method are encouraged to read the BEA RIMS II handbook, "RIMS II: An Essential Tool For Regional Developers and Planners," to understand data management basics and bill of goods analysis procedures.

In this analysis, I am applying a detailed BOG evaluation, but I am using the total spending by category, and I am going to allow the default IMPLAN local purchase coefficients to allocate the in-state and the out-of-state spending.

The first step is to begin with a model of your study area – for this I am using the state of Iowa. I am not making any adjustments to this model because a BOG approach substitutes for creating a dedicated sector. The next step is to get a table of university expenditures that aligns with (RIMS II) or IMPLAN industrial categories. Table 3 is a very partial list of ISU total spending. Items in grey are either grey areas that required special treatment (wholesale margins, for example), or categories of spending that require additional information (for construction, we have excluded new construction and including only repair and maintenance construction activity, for example).

TABLE 3

ISU Major Spending Categories –Partial List

RIMS II Codes	RIMS Explanation	Total
	Ag and ag services	
1111C0	Oilseed and grain farming	1,192
1119C0	All other crop farming, including sugarcane and sugar beet farming	1,609,693
1121A0	Cattle ranching and farming	15,546
112A00	Animal production, except cattle and poultry and eggs	281,584
115000	Support activities for agriculture and forestry	836,569
	Utilities	
2211A0	Electric power generation, transmission, and distribution	1,895,206
221200	Natural gas distribution	79,435
230000	**Construction**	96,505,812
	Manufacturing related	
311119	Other animal food manufacturing	101,948

323110	Printing	2,469,726
325188	All other basic inorganic chemical manufacturing	1,277,161
325310	Fertilizer manufacturing	189,984
325320	Pesticide and other agricultural chemical manufacturing	258,835
325412	Pharmaceutical preparation manufacturing	1,506,012
327320	Ready-mix concrete manufacturing	33,360
	Wholesale	
420000	Wholesale trade: general supplies	29,860,368
420000	Wholesale: Computer equipment	2,761,402
420000	Wholesale: Equipment	280,212
420000	Wholesale: Office furnishings & equipment	17,183,026

Next, go to the **Analysis / Set-up Activities** portion of the main menu. When it opens, you create and name an activity, and then you start entering in separate events to replicate the BOG analysis (see Figure 4). You enter categorical totals under the Industry Sales column. The default employment, employee earnings, proprietor incomes, and the model-set local purchase coefficients (LPC) are then filled-in. I am not adjusting the LPCs because in this exercise I do not have a clue about the probability of a local purchase – I only know university total expenditures, and I am letting model-derived LPCs guide the remaining process.

> ***A special note on trade margins is in order. In either retail or wholesale spending categories, the model will prompt you whether the amount that you entered represents the total value (i.e., the price paid) or the margined value. Here, you will enter that it is the total value, and you will let IMPLAN select the model-default trade margins to apply to that total value. Again, for readers unfamiliar with trade and transport margining procedures, please refer to the RIMS II Handbook (see previous footnote) for an explanation of how to properly handle these spending categories and why.***

One last point here: You are perfectly able to adjust the LPCs to reflect reality. In Figure 4 the model assumes that a mere 25 percent of the grains purchased by the university would be locally supplied. As Iowa is a net exporter of grain, it would be OK to adjust that LPC upward. That is an option under **Event Options**. These adjustments, however, should be reasonable and based on actual analysis (for example a location quotient or some such other regional shares measure that one is comfortable defending).*

* Astute readers will notice that the grain and animal numbers from Table 3 have been collapsed into two categories for the IMPLAN analysis. I did that because I am lazy. Readers will also see that agriculture

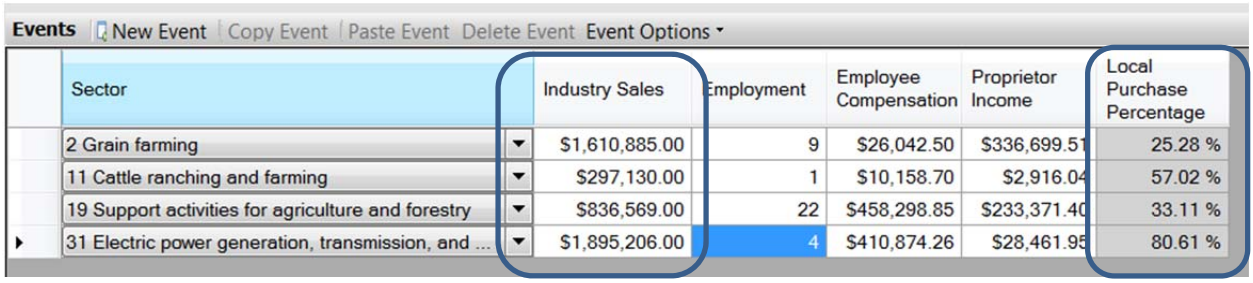


FIGURE 4: ENTERING LINE ITEM INPUT VALUES

You move next to the **Analyze / Scenarios** portion of the model, select your activity and analyze your selection. The model will then produce a summary of the results. This first of two analyses takes care of all indirect activity plus the induced effects those supply and service purchases stimulate. Employee income effects need to be calculated next to round-out the evaluation for this method.

For the employee income effects, you need to create a new activity for household spending (see Figure 5). Here my activity is household total income change, and I have selected the $35-50k group because, as revealed earlier, the average labor income for my university was $40,134 (see *Table 1). I include all of labor income here (wages, salaries, plus benefits), and I let the IMPLAN* modeling coefficients allocate our household spending to taxes, savings, and to expected household consumption for that income group.

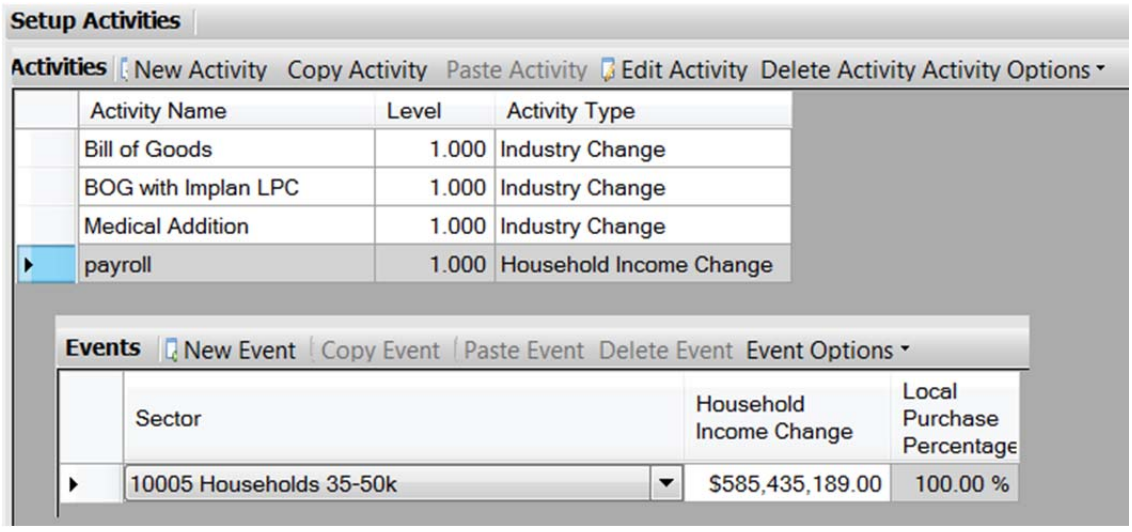


FIGURE 5: MODELING EMPLOYEE INCOME

support activities and electric power are exactly as reported, as were the remaining values that were entered. Honest.

Once all of the analysis has been completed for the two activities, a table combining direct, indirect, and induced activity can be constructed. Table 4 informs us of the findings. In all, this simpler BOG approach estimated 21,132 jobs earning $825.4 million in labor income, and total university output considering all direct, indirect, and induced transactions summed to $1.48 billion. These values are higher than those reported in Method #1.

TABLE 4

Bill of Goods: IMPLAN LPCs*

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	14,587	585,434,688	585,434,688	796,887,808
Indirect Effect	753	29,588,367	42,485,552	74,680,334
Induced Effect	5,792	210,338,528	367,338,594	610,606,280
Total Effect	21,132	825,361,583	995,258,834	1,482,174,422

METHOD #3. BILL OF GOODS ANALYSIS USING KNOWN LOCAL PURCHASE VALUES

As mentioned earlier, my university provided me information for over 56,000 line item expenditures along with the zip codes of the payees. I was therefore able to allocate spending to in-state suppliers. And that means that I can perform a much more precise BOG analysis of my university.

Table 5 tells us the amounts of the total expenditures in Table 4 above that were in-fact purchased from in-state suppliers.

TABLE 5

ISU Major Spending Categories

RIMS II Codes	RIMS Explanation	In State
	Ag and ag services	
1111C0	Oilseed and grain farming	1,192
1119C0	All other crop farming, including sugarcane and sugar beet farming	1,504,967
1121A0	Cattle ranching and farming	15,546
112A00	Animal production, except cattle and poultry and eggs	23,893
115000	Support activities for agriculture and forestry	553,673
	Utilities	
2211A0	Electric power generation, transmission, and distribution	1,894,242
221200	Natural gas distribution	74,433
230000	**Construction**	61,171,298

	Manufacturing related	
311119	Other animal food manufacturing	92,294
323110	Printing	1,184,434
325188	All other basic inorganic chemical manufacturing	17,697
325310	Fertilizer manufacturing	189,871
325320	Pesticide and other agricultural chemical manufacturing	196,767
325412	Pharmaceutical preparation manufacturing	1,656
327320	Ready-mix concrete manufacturing	24,950
	Wholesale	
420000	Wholesale trade: general supplies	14,839,936
420000	Wholesale: Computer equipment	380,810

Figure 6 shows what the event specification looks like. I entered the amounts from Table 5 for each of the relevant sections. I next set the **Local Purchase Percentage** to **100 percent**, and the model then determines the expected employment, compensation, and proprietor income values. In this example, when it comes to wholesale purchases, I have now entered the margined values (net of the cost of delivered goods sold). Once all transactions are entered, as before, you move next to the **Analyze / Scenarios** portion of the model, select your activity and analyze your selection. The model will then produce a summary of the results for the BOG analysis.

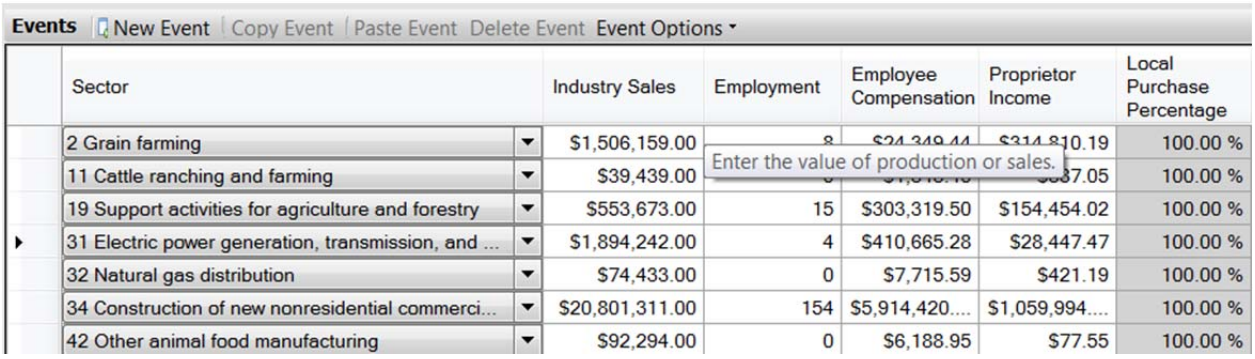


FIGURE 6: ENTERING KNOWN LOCAL INDUSTRIAL PURCHASES

This analysis is a more precise estimation than the previous estimate, but the employee spending component is exactly the same as in the previous example. When you combine the two results, you can construct an estimate of the expected total BOG-determined economic contribution of my university. Table 6 presents the findings. I get 21,206 total jobs earning $826.14 million in labor income, and $1.48 billion in output.

TABLE 6

Bill of Goods: Local Purchases are Known

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	14,587	585,434,688	585,434,688	796,887,808
Indirect Effect	822	30,205,751	46,944,632	80,475,967
Induced Effect	5,797	210,500,037	367,631,441	611,092,912
Total Effect	21,206	826,140,476	1,000,010,761	1,488,456,687

Readers will note that there is not very much difference between Table 4 and Table 6. This may simply be an artifact of the Iowa model and should not be used as an excuse to not conduct the most precise evaluation possible. Method #3 – a detailed BOG with known local spending levels – is superior to the default model and all of the other methods demonstrated in this handout, and it should be done if the data allow it at your institutions.

METHOD #4. A HYBRID APPROACH TO BILL OF GOODS: MODIFYING THE PRODUCTION COEFFICIENTS

This is a method that I will employ when I have a moderately detailed schedule of inputs for a firm, but I want to split the difference between Method #1 and the more rigorous efforts in Method #3. It involves using the model that was modified and used for Method #1, but making amendments to the model's direct coefficients for the newly-created public university sector of the model.

To modify the model, however, I need some sense of my university's supply needs. Table 7 shows the fractions of direct university total spending as a percentage of estimated university output for fiscal 2010.

TABLE 7

RIMS II Code	Spending Category	Percent of Total Spending
230000	Construction: Repair and modernization of existing buildings	2.61%
541300	Architectural, engineering, and related services	1.41%
531000	Real estate	1.25%
561900	Other support services	1.21%
524100	Net All other insurance	1.02%
541700	Scientific research and development services & other inter-institutional contracts	0.79%
511200	Software publishers	0.56%
561700	Services to buildings and dwellings	0.54%
485A00	Transit and ground passenger transportation	0.42%
420000	Wholesale: Research and lab equipment	0.38%
420000	Wholesale: Computer equipment	0.35%

323110	Printing	0.31%
522A00	Nondepository credit intermediation and related activities	0.31%
420000	Wholesale trade: general supplies	0.25%
541610	Management, scientific, and technical consulting services	0.25%

As I have already balanced this model with regard to labor income and employment, I am next going to adjust the industrial production coefficients that go with this sector. So, I first go to **Customize / Industry Production** and select **Sector 392**. As can be seen by Figure 7, I have already allocated 73.5 percent of output with our value added (labor income) adjustments in Method #1. Now I need to modify the production coefficients.

My method is to use just the top 10 or 15 expenditure categories so that I make sure the model is recognizing the most important inputs, and I enter those fractions into the model (see Figure 8). Here I modified the top 15 sectors. Once those coefficients have been entered, the analyst then **Balances** the model and all other spending is reapportioned across the remaining university expenditures. Next, I must reconstruct the multipliers (see Figure 3).

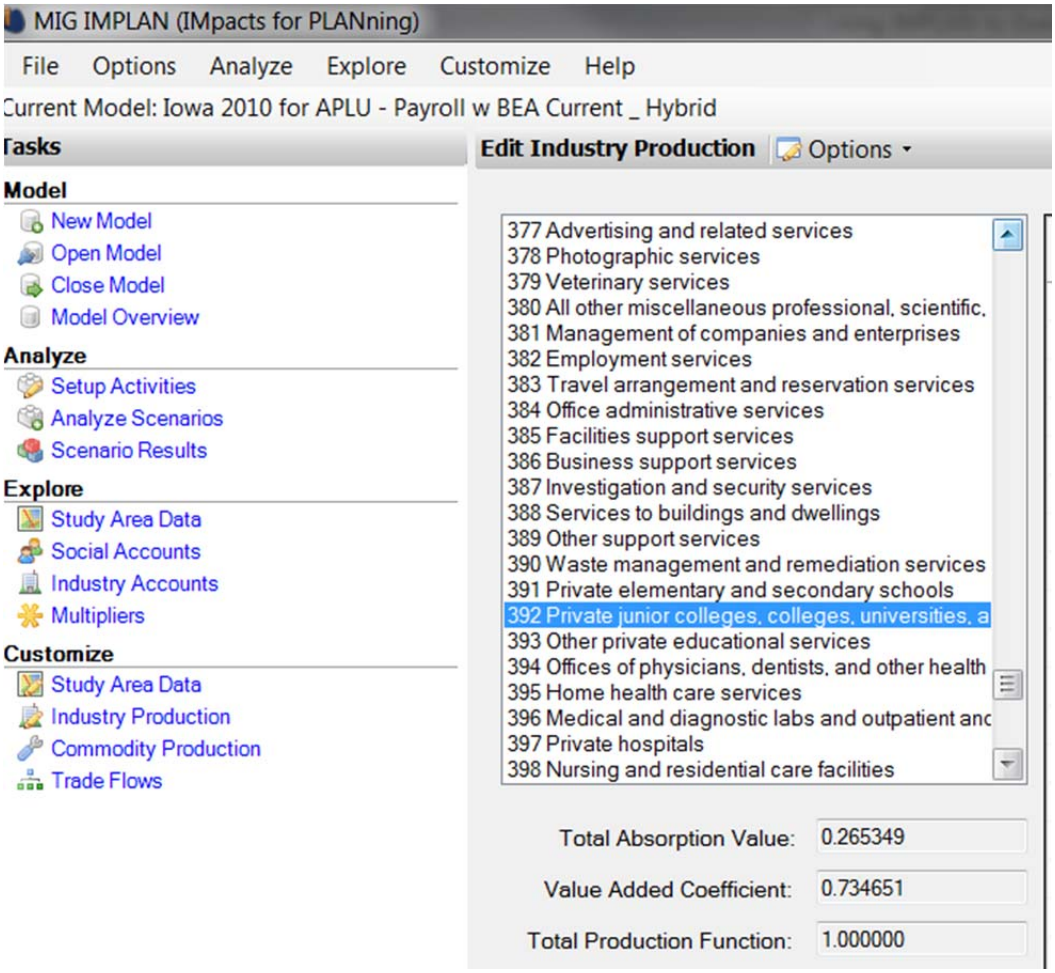
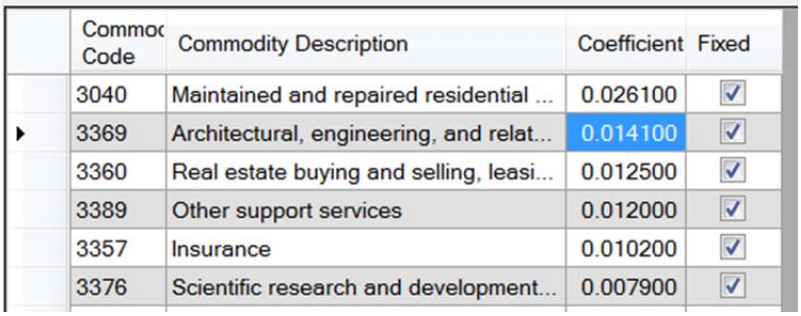


FIGURE 7: MENU FOR CUSTOMIZING INDUSTRY PRODUCTION COEFFICIENTS



Commod Code	Commodity Description	Coefficient	Fixed
3040	Maintained and repaired residential ...	0.026100	☑
3369	Architectural, engineering, and relat...	0.014100	☑
3360	Real estate buying and selling, leasi...	0.012500	☑
3389	Other support services	0.012000	☑
3357	Insurance	0.010200	☑
3376	Scientific research and development...	0.007900	☑

FIGURE 8: TABLE OF MODIFIED COEFFICIENTS

This produces a hybrid approach (part Method #1 and part Method #2), and the shock to the model to produce your results is now the same as in Method #1: either enter the output value or the employment value and run the scenario through to the output results.

Table 8 displays the results. The hybrid model estimated 20,676 jobs making $814.72 million in labor income, and $1.46 billion in total output – fewer jobs than the previous two BOG examples.

TABLE 8

Value Added Adjustment With Modified Direct Coefficients (HYBRID)

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	14,587	585,434,688	585,434,688	796,887,808
Indirect Effect	1,212	51,834,736	77,998,554	137,714,057
Induced Effect	4,877	177,030,549	317,997,867	520,951,760
Total Effect	20,676	814,299,973	981,431,109	1,455,553,625

CONCLUDING THOUGHTS

Were I not participating in this larger project and actively sponsored by university administration, an evaluation of the highly detailed university spending (#2 and #3) would have been difficult, and convincing our accounting folks to give me payee zip codes (#3) would have been met with outright derision. As it was relayed to me, the data set required a lot of clean-up before they were willing to release the information (there are advantages to having one's provost enthusiastic about your analysis: it's another to initiate the request at the staff level). Accordingly, I often use a version of Method #4 in my work.

Nonetheless, public universities must be forthcoming about major expenditures, and it is reasonable to request breakdowns in greater detail than might be usually reported for the general public. Asking for data totals within a university's own expense classification system is not unreasonable, and should be of no trouble to obtain. Given that, and usually only knowing broad categorical spending totals, the hybrid (#4) method is frequently most expedient for me. Given the chance, however, if I can do a detailed BOG with known local expenditures (#3), if the data are there, I always choose that method over any easier approach.

IO analysis is not precise. All IO models, especially so at the state and sub-state levels, contain large amounts of estimated data for jobs, labor incomes, value added, and output. Inter-industrial relationships are econometrically contrived based primarily on national numbers and regional adjustments for trade flows or apparent supply and demand relationships. Nonetheless, as this exercise demonstrated, IO done with reasonable standards of care produces remarkably similar results.

One last comparison highlights the across-method similarity of results. BEA, as part of this larger initiative, did a thorough BOG analysis of Iowa State University using RIMS II multipliers and developed very precise definitions of output; I gladly deferred to their determination of ISU direct output in the production of the four approaches displayed thus far. Table 9 compares the results of the four ISU analyses revealed here with the BEA's evaluation (as slightly modified for income-definition compatibility). The BEA's work (with my additions) resulted in 20,013 jobholders

making $767.45 million in labor income, and $1.44 million in industrial output. Again, there are comparatively small differences across all of the approaches. The mean absolute deviation in jobs was 1.9 percent, labor income 2.6 percent, and output 1.6 percent. And finally, as the bottom half of the table demonstrates, for all practical purposes there are very little difference in the total multipliers that resulted from this exercise.

TABLE 9

A Comparison of Results for Iowa State University

	Total Economic Contributions		
Type of Analysis	Jobs	Labor Income	Output
Method #1. Value Added Adjustment With Adjusted University Operational Output	20,390	788,057,820	1,420,073,392
Method #2. Bill of Goods: IMPLAN LPCs	21,132	825,361,583	1,482,174,422
Method #3. Bill of Goods: Local Purchases are Known	21,206	826,140,476	1,488,456,687
Method #4. Value Added Adjustment With Modified Direct Coefficients (HYBRID)	20,676	814,299,973	1,455,553,625
BEA RIMS II (with my labor income definition)*	20,013	767,447,882	1,435,295,846
Mean absolute deviation	*1.9%*	*2.6%*	*1.6%*
Average	*20,683*	*804,261,547*	*1,456,310,794*

	Total Multipliers		
Type of Analysis	Jobs	Labor Income	Output
Method #1. Value Added Adjustment With Adjusted University Operational Output	25.587	0.989	1.782
Method #2. Bill of Goods: IMPLAN LPCs	26.519	1.036	1.860
Method #3. Bill of Goods: Local Purchases are Known	26.612	1.037	1.868
Method #4. Value Added Adjustment With Modified Direct Coefficients (HYBRID)	25.946	1.022	1.827
BEA RIMS II (with my labor income definition)*	25.114	0.963	1.801

**Note: Initial BEA estimates for Iowa did not include employer contributions to health insurance in their employee earnings definition. My addition to the BEA results translates employer health insurance payments as induced medical spending by university employees.*